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AIR TECHNICAL INTELLIGENCE CENTER
WRIGHT-PATTERSON AIR FORCE BASE
OHIO

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Central Intelligence Agency
2430 E St., N. W.
Washington 25, D. C.

Gentlemen:

We are inclosing a copy of Mr. Ivan Kenis' presentation at the Propellants Seminar, 14 June 1956, sponsored by the Economic Defense Intelligence Committee. You may use this copy in your compilation of papers presented at the Seminar. Air Technical Intelligence Center would be pleased to receive copies of the papers. (UNCLASSIFIED)

Sincerely,

C. J. CONNAIR, JR.,
MAJOR, USAF,
Adjutant

1 Incl (Dup)
Some Aspects of Soviet
Solid Propellant
Technology (S) T56-13722

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SOME ASPECTS OF SOVIET SOLID PROPELLANT TECHNOLOGY

Ladies & Gentlemen -

Nothing would please me more than to be able to give you "some aspects of foreign solid propellant technology" - as my presentation has been called in the agenda. Foreign solid propellant technology I know is meant to be Soviet solid propellant technology. And I repeat, nothing would give me greater pleasure than to be able to give you an extensive review of the Soviet work. Unfortunately, that which we know of the Soviet solid propellant research and development is very fragmentary and much of it is speculative. Whereas we enjoy a somewhat favorable position in the knowledge of their liquid propellant technology, this cannot be said for the solid propellant area.

However, we feel that whatever information we have should be disseminated; and our program to obtain more information should lend some encouragement that the most that can be accomplished under the circumstances is being done.

As I understand the purpose of this Seminar, it is to assist those of you who are charged with matters of trade and export to control the flow of vital raw materials, and products, to the Soviet bloc. Based on what has been said here today and yesterday by the previous speakers, I can say that, with few exceptions, there is little that the Soviet Union needs in the solid propellant area that she cannot obtain within the boundaries of the USSR, or certainly within the Soviet Bloc.

The Air Technical Intelligence Center has been studying the Soviet solid propellant picture on an intensified basis for more than eighteen months. We have pooled our resources with the Navy and Army and CIA; and after a good look at the classified data, we have decided to attack this problem through a thorough study of the Soviet scientific literature. This program has been undertaken by a qualified contractor and is now nearing completion, however, it is too early to draw any firm conclusions from the literature study. We feel that the findings must be integrated with the classified data that are available before a convincing and reasonable assessment can be made of the Soviet state-of-the-art in the solid propellant field.

Let me point out reasons for my last statement that may not be apparent to you. First, in our Soviet literature search we must look into three principal areas: (1) the material which comprises some portion of the finished propellant, (2) the scientist who contributes to the Soviet solid propellant effort,

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and (3) the institutions where the research is conducted. Because propellant materials are not single purpose materials, that is, they can be used in many non-propellant applications, careful analysis must be made of research in a given material area to insure that the papers are not misleading in either direction. Next, we search out all the papers published by a particular scientist to determine again, whether they constitute propellant work per se, or whether they have alternate applications but could also provide a propellant capability. Finally we seek out the institutions where work of interest is conducted. And here we have some of our greatest problems.

Whereas we can eventually assess the value of a group of papers on a given material or chemical compound or reaction, and we can usually identify those scientists who contribute most to the work, it is difficult to determine and confirm exactly where this work is conducted. For example, institutes under the Ministry of Agriculture often have large military programs. The Central Scientific Research Institute of the Leather Industry conducts research on nitrocellulose materials. Of course, cases such as these are relatively easy to identify when we are presented with the evidence, but you can readily see that there are far less discernible cases. It is here that we hope to integrate some of our classified data to give us a more realistic picture and to help us identify otherwise obscured work.

I would like to touch briefly on some specific propellants to give you an appreciation of the extent of our knowledge of the position of the Soviets. We believe that their technology in the double-base propellant area - nitrocellulose-nitroglycerin type - is good and perhaps equivalent to the US. This is not a statement to merely credit the Soviets with a capability equivalent to ours because of the lack of positive information. We know that they exhibited a keen knowledge of double-base powder manufacture during World War II. Their cordite was a lower temperature and slower burning material than US compositions but suitable for their needs. They continued developments with double-base formulations and we know that as of late 1951 the double-base material was the propellant employed in several rocket missile designs. They also used a double-base propellant in their seat-ejection cartridge of the MIG-15. In addition to nitrocellulose-nitroglycerin types, they have done some work with the German type: dinitrodiethylene glycol-nitrocellulose.

At the present time we have practically no data on composite propellant formulations. We do have, however, an assessment of their capability to produce suitable binders. We know also of their intense interest in the inexpensive oxidizer, ammonium

nitrate. We have all kinds of indications that might lead us to assign to the Soviets the capability to develop a cheap composite propellant based on ammonium nitrate. One thing is missing, and this is the positive assurance that they have it in being. We hesitate at this time to make a firm estimate until we have had more time to integrate the classified and unclassified data.

However, in spite of our limited knowledge of Soviet solid propellant technology, it is evident to us, that, were we to possess considerably more information, it would not alter the fact that there is very little in this area in terms of propellant ingredients that we could deny them. In other words, there are very few ingredients of solid propellants known to us that the Soviets could not produce in quantities sufficient to their needs.

The one area of propellants where the Soviets may be suffering from the lack of suitable raw materials, is in the boron propellants. An investigation recently prepared for ATIC on boron resources of the USSR and satellite nations, reveals that, while the Soviet Union has a sizeable reserve of boron ores, it does not possess ores that are easily processed. For example, sodium tetraborate, or what is commonly referred to as borax, is almost unavailable to the Soviets. As you know, borax is the most desirable mineral from the standpoint of a suitable raw material for the high energy fuel program. In the USSR borax is available only in the Crimean volcanic muds in a concentration of 0.3 to 0.4% on a boric oxide basis. Compare this with the US borax deposits of the Kramer area of California or the Searles Lake brines where the B_2O_3 concentration is over 2.8 percent. Aside from the wide degree of difference in concentration, the Soviet borax deposit is such that concentration beyond a technical grade is difficult.

Because of the low grade of borax available to the Soviets, they must pursue one of two alternative courses. The first alternative is to process their Inder Lake and similar deposits which are high in B_2O_3 content, an average of 25%, but which consist of many different types of ores, (eleven in number) each requiring a different method of processing. These processes consist of sulfuric acid or phosphoric acid digestion for the magnesium borate mineral (ascharite), or the carbon dioxide digestion of the magnesium-calcium borate mineral (hydroboracite), and many other processes, each of which are considerably more complicated and expensive than a simple crystallization process to recover borax from brines or soluble salt deposits. Their other alternative is to purchase refined borax on the world markets, and I surmise from this Seminar that the control of this source is to some degree the decision of this audience.

To be sure, the denial of borax from the Western markets would not bankrupt the Soviet high energy fuel program - and ATIC is convinced that they have a high energy fuel program based on boron - it would merely make a phase of their problem more difficult. When one realizes that it takes 6.5 tons of refined borax (sodium tetraborate plus ten molecules of water of crystallization) to produce one ton of a typical high energy fuel on a 100% theoretical efficiency basis, one can soon see the significance of each shipment of borax the Soviets receive from Western sources. Of course, the conversion process does not approach 100% by a large margin and therefore each shipment of borax they receive goes up in significance if we assume they are in an advanced development program.

I want to point out that boron compounds have application in liquid rocket engines, air-breathing engines such as turbojets and ramjets, and for solid propellant compositions. Energy increases, in terms of heat content, as the result of their use can be as high as 50 - 70% over the fuel they would replace, but from a practical point of view perhaps 30% would be a more realistic figure. In the case of aircraft this increase is translated into increased range, and to a degree into increased velocity. In rockets it means greater thrust and therefore increased range and velocity. But regardless of how we assign the performance increase the use of boron compounds can always be translated into a smaller and lighter weapon to accomplish a given mission.

I realize that I have not given you much of a picture of the Soviet solid propellant technology - I informed you at the beginning that I would be unable to do so. However, I hope that my remarks have provoked some questions. To the best of my ability I will try to answer them - Thank you.

The over-all classification of this presentation is Secret.